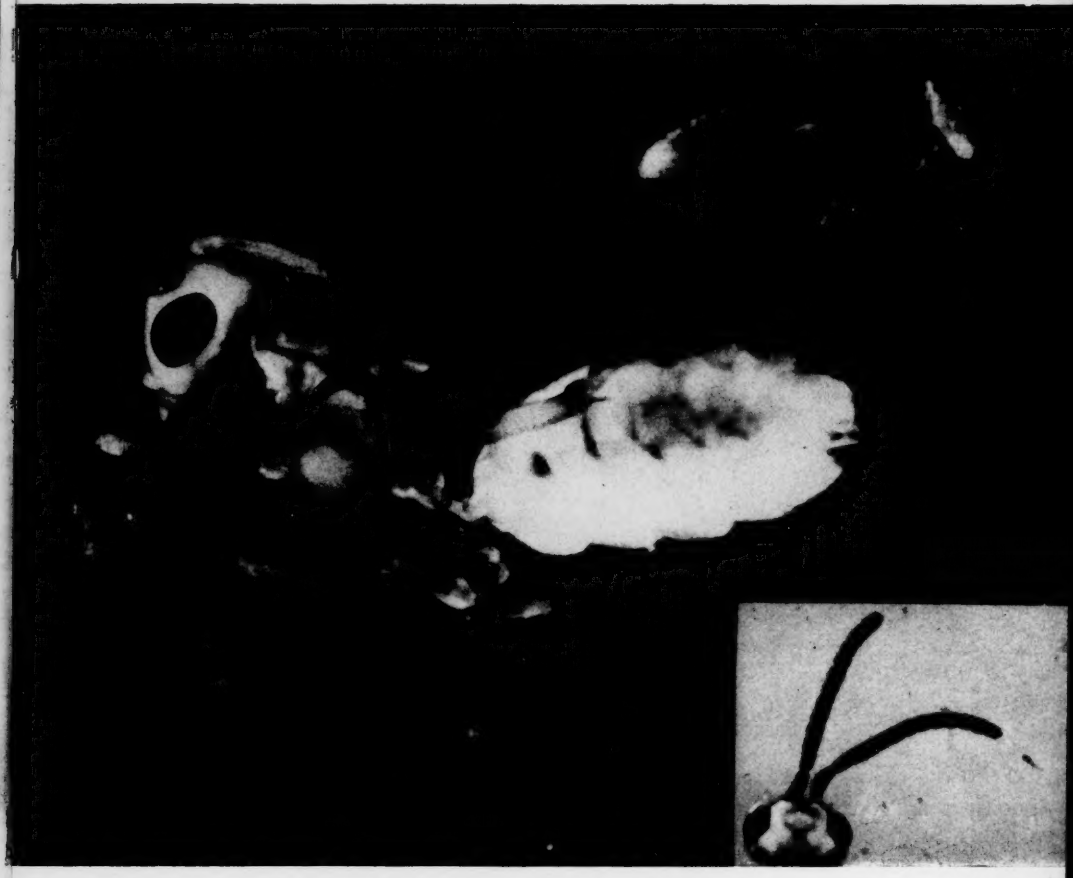
The Journal of HEREDITY



ANTENNAL LEGS AND UNLAID EGGS

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One Species of Human Beings—Or Five?

Skin Defects in Cattle

Small-Eyed Swine

Hereditary Food Allergy

Frost-Hardy Tomatoes

VOLUME 39 MAY, 1948 NUMBER 5

The American Genetic Association

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The

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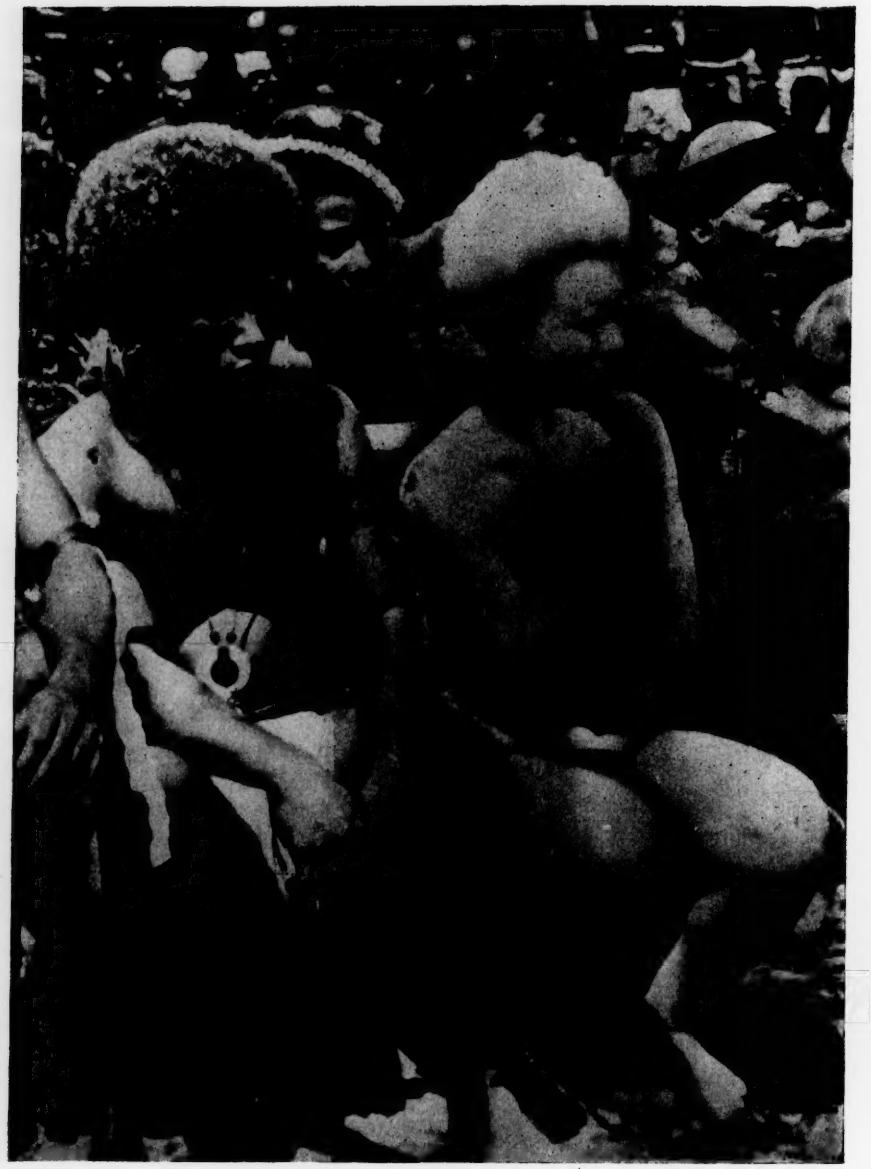

Associated Press Photo

TROBRIAND ALBINO

Figure 1

Albinism crops out at varying rates in many, if not in all, branches of the human race. Its highest frequency is probably among the San Blas Indians of Northern South America, where as many as seven babies per hundred are reported to be albinos. Across the Pacific among the Trobriand Islanders albinism is said to be very rare, and this allegedly unique photograph has for that reason a place in the record of human genetic variation. The Coral Islanders are said to take exceptional care of their "white" relatives, who are nearly blinded by the brilliant tropical sun.

HEREDITARY EPITHELIAL DEFECTS IN AYRSHIRE CATTLE

F. B. HUTT* AND J. N. FROST†
Cornell University, Ithaca, New York

ABOUT 20 years ago, Hadley and Cole[2] described a hereditary defect in Holstein-Friesian cattle that is characterized by raw areas devoid of skin on the lower parts of the legs, one or more undeveloped claws, malformed ears with adhesions of the inner surfaces, defects in the integument of the muzzle and in the mucous membrane of the nostrils, tongue, hard palate, and cheeks. To this assortment of abnormalities they gave the name, *epitheliogenesis imperfecta neonatorum bovis*. The condition is inherited as a simple, recessive, autosomal character and is lethal, as all the affected calves soon die, apparently from septicemia. The same abnormality was later reported from the Netherlands by Kroon and Van der Plank,[5] who found it in Friesian cattle related to the Wisconsin stock studied by Hadley and Cole.

About 13 years ago, a similar condition, but with more extreme deviations from normal, was found in Jerseys by investigators working independently in California[7] and in Texas.[10] On putting their reports together for publication in this journal, the editor[1] was able to show that the affected calves in both states traced to common ancestors.

The present note is written to record a defect found in Ayrshires that is similar to that in Holstein-Friesians and probably identical with it.

Description

Four calves with this abnormality were born in one herd within six months, but only the last of these was available for examination by the time the case became known to us. It was brought to the Veterinary College here early in March, 1947, when it was about a week old. Details concerning the other three were obtained from the owner.

The calf examined here had bare areas on the knees, but no corresponding lesion on the hind legs. Overlying the fetlock joints of all four legs there were extensive areas devoid of normal skin and covered with great scars (Figure 2). Some of these contained little "islands" of normal skin, and all had a fringe of the same between the raw area and the hoof. It is noteworthy that the location and extent of these lesions were remarkably symmetrical on the right and left members of both the front and hind legs. The hoofs were apparently normal, and the calf had no difficulty in standing.

A raw area on the muzzle extended between the nostrils and slightly into the left one (Figure 3). The lower lip and chin were normal. Inside the mouth the only lesion observed was an extensive area on the under surface of the tongue that lacked the normal mucosa. The upper surface was unaffected. Dentition was normal. There were no lesions in the ears, which were of normal shape.

At post-mortem examination, Dr. C. P. Zepp found in the oesophagus a strip one-half inch wide and running right down to the omasum that lacked the normal mucosa.

The owner of the calf stated that the specimen described above was typical of the four born in his herd, except that one of the other three had lesions on the inner surface of the ears.

Breed Differences

It is evident from the description given above that the abnormalities caused by this mutation are fewer and less exten-

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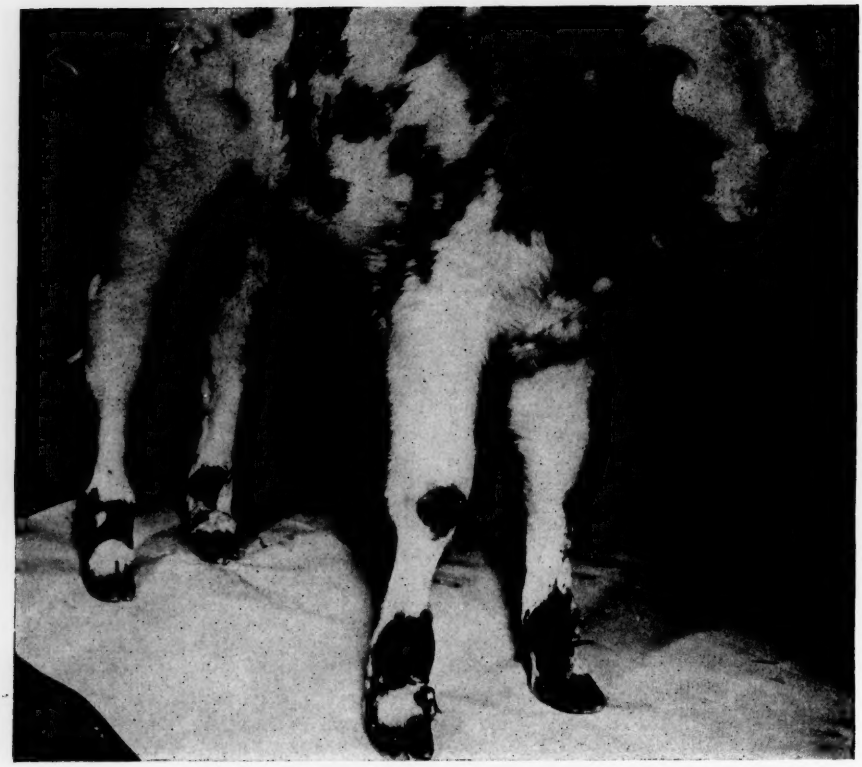

CALF WITH RAW HIDE

Figure 2

Calf showing the raw areas lacking normal skin on the knees and at the distal extremities of all four legs, above the hoofs.

sive in these Ayrshire calves than in the Holstein-Friesians described by Hadley and Cole, and the Friesians* observed by Kroon and Van der Plank.

There is a corresponding difference in viability. The calf shown in Figure 2 was kept on soft feed with a little whole oats, but no roughage. Sulphathaladine was given as protection against infections. In spite of this special care, the animal did not thrive, and was therefore destroyed on June 11 when about three-and-a-half months old. By that time, the scabs on the raw areas had dropped off leaving all the lesions healed and covered with scar tissue. The muzzle was apparently normal. The owner reported that the other three calves with similar defects had all been kept for two or three weeks and then sold for veal.

These histories are in marked contrast with those of similarly affected Holstein-Friesian calves.[2] Some of them were weak and unable to stand. Others were strong at birth, but all soon became debilitated and died, even when given good

*The cattle called Holstein-Friesians in the United States are known as Friesians in the Netherlands, whence most of them originated.

care. Death was attributed to septicemia following invasion of the raw areas by infectious organisms.

The condition in the Jerseys is much more serious. The seven calves reported by Wipprecht and Horlacher[10] from Texas were apparently all born prematurely and some, if not all, were stillborn. Of the four recorded by Regan *et al.* in California, three were born prematurely and the fourth had died three weeks before full term. One of the three lived only six hours; the others were destroyed before a day old.

All of these Jersey calves had extensive areas on the head, the legs, and other parts of the body that were devoid of normal covering. Other abnormalities were much more extreme than in the Holstein-Friesians with epithelial defects. There is some doubt, therefore, of the extent to which this abnormality in the Jerseys may be attributable to the same mutation as that in the other two breeds. At the same time, one must recognize that (1) the effects of any one mutation usually depend greatly upon the genic complex in which it operates, (2) Jerseys must differ from other breeds in many genes, and hence (3) the same mutation might be responsible for the epithelial defects in all three breeds.

The abnormalities of these Ayrshires resemble those in Holstein-Friesians so much that the causative mutations may reasonably be considered as identical, with the differences in severity of the effects resulting from genetic differences between the two breeds. Positive proof for that assumption could be provided only by matings of heterozygous Ayrshires with heterozygous Holstein-Friesians. If any of the progeny should show the defect, the mutations would be proven identical, but if none show the defect (in 12 or 15 calves) that hypothesis would be disproven. Although such a test is standard procedure with laboratory animals and with fowls, it is not likely to be made with larger animals unless some interested breeder can be persuaded to undertake it. So far as we are aware, the only test of this sort ever made with cattle was that in which T. H. Riches, by crossing Dexters with Telemarks, demonstrated that the different degrees of achondroplasia found in these two breeds are caused by two different genes (Punnett).[6]

Genetic Basis

The four calves considered in this report were all sired by the same Ayrshire bull, Mansfield May's Augie, 71621. The cows that produced them were all sired by another Ayrshire bull, Whitpain Skytop, 64058. These two bulls have common ancestors.

From these facts, together with the evidence concerning the same abnormality in Holstein-Friesians, it is evident that the defect is inherited and probably caused by an autosomal recessive gene in the homozygous state. It is clearly recessive, because none of the parents showed any sign of skin defects. It is obviously autosomal, for the sex-ratio was 3 ♀♀ : 1 ♂.

Evidence that mutation of a single gene is responsible is hardly conclusive, but such evidence is always more difficult to get with large mammals than with mice. Mansfield May's Augie sired in this herd 30 calves, in which the ratio was 26 normal:4 defective. If all the cows to which he was bred were daughters of his predecessor as herd sire (who was also heterozygous for the causative gene (about half of them should have carried the gene and half should not. The expected ratio, if that were so, was 7 normal:1 abnormal in the 30 calves from Mansfield May's Augie, or, in whole numbers, exactly the 26:4 that was observed. Although such an exact attainment of the expected number is so unusual as to be suspect, there are indications that the true situation was exactly as outlined above.

The herd had originally consisted of grade cows until the owner decided to improve his stock by using only registered Ayrshire bulls. The first of these was Whitpain Skytop. By the time this bull's daughters were old enough to

VIEW OF THE MUZZLE LESION

Figure 3

Face of the calf shown in Figure 2, with defective integument on the muzzle, between the nostrils.

breed, a new herd sire, Mansfield May's Augie, was purchased to avoid inbreeding. With the policy of gradually eliminating the grades and keeping only daughters of the first registered bull, it seems obvious that the second pure-bred sire would be mated almost exclusively with daughters of the first. If both bulls were heterozygous for a recessive autosomal gene for epithelial defects, the 7:1 ratio in the progeny of the second sire was only to be expected.

The possibility that the cows producing the four abnormal calves could have received the causative gene from their dams, rather than from their sire (Whitpain Skytop) was considered but soon eliminated because, while two of the cows were full sisters, the others were not related to them at all. It is obvious that these four cows were more likely to have gotten the gene from their common sire than from three different dams.

The symbol, *ep*, used by Hadley and Cole for this mutation in Holstein-Friesians should also apply to the same gene in Ayrshires.

What Ayrshires Carry the Gene Now?

The only way to answer this important question is to trace the lines of descent of the affected calves down from common ancestors. The information available from pedigrees of the two bulls known to have carried the gene is too limited to permit identification of any other heterozygotes. It does indicate animals that may be responsible for transmitting the gene if found in the ancestry of other calves with epithelial defects. With further information, it is probable that most of the immediate ancestors of the four affected calves will be cleared of suspicion and that a few will be identified as transmitters of the gene. For that reason, the pedigrees of the two known heterozygotes are given here for five

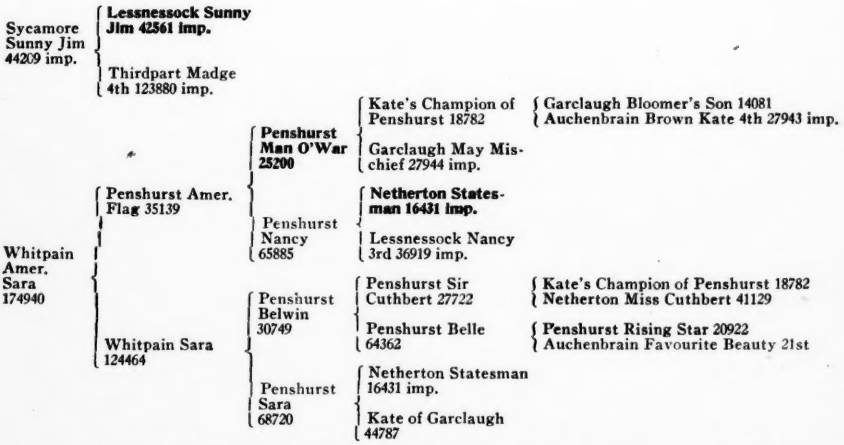
Sycamore Sunny Jim 44209 imp.
Lessnessock Sunny Jim 42561 imp.
Thirdpart Madge 4th 123880 imp.
Penshurst Man O'War 25200
Kate's Champion of Penshurst 18782
Garclaugh Bloomer's Son 14081
Auchenbrain Brown Kate 4th 27943 imp.
Garclaugh May Mischief 27944 imp.
Penshurst Amer. Flag 35139
Netherton Statesman 16431 imp.
Penshurst Nancy 65885
Lessnessock Nancy 3rd 36919 imp.
Whitpain Amer. Sara 174940
Penshurst Belwin 30749
Penshurst Sir Cuthbert 27722
Kate's Champion of Penshurst 18782
Netherton Miss Cuthbert 41129
Penshurst Belle 64362
Penshurst Rising Star 20922
Auchenbrain Favourite Beauty 21st
Whitpain Sara 124464
Penshurst Sara 68720
Netherton Statesman 16431 imp.
Kate of Garclaugh 44787

CHART I. *Ancestry of Whitpain Skytop.* **Ayrshire bull known to have been heterozygous for epithelial defects. Individuals in bold face type appear also in the pedigree of Mansfield May's Augie (Chart II).**

generations (Charts I and II). We are indebted to Mr. C. T. Conklin, Secretary of the Ayrshire Breeders' Association, for generous help in completing pedigrees for animals registered after publication of herd books was suspended.

The nearest common ancestor of these two bulls is Penshurst Man O'War, who was a maternal great grandsire of Whitpain Skytop. He also appears once in the fourth generation and twice in the fifth generation back of Mansfield May's Augie. These facts do not prove that he carried the gene, but they suggest that he may have done so. The imported bull, Lessnessock Sunny Jim, appears in both pedigrees. So does another imported bull, Netherton Statesman, who, though not shown in the pedigree of Mansfield May's Augie, was the sire of the cow, Penshurst Ada, shown in the fifth generation of that pedigree.

Further speculation about which of these animals might have carried the gene will be unprofitable until more of the affected calves have been found and their pedigrees traced.

Comparative Genetics

It is always of interest when mutations with the same effects are found in different species. A hereditary abnormality observed in horses by Van der Plank[9] is described by him as completely analogous with the epithelial defects as found in Friesian cattle. Five foals by one sire, and from mares related to each other and to the sire, had extensive areas on the legs that lacked hair and resembled a tanned hide. In some of these a hoof was lacking—or incompletely attached to the skin. One had a denuded area on the rump. All these foals died in a few days.

Some mutations (*e.g.* albinism and achondroplasia) occur in many or several different kinds of animals. Others seem to be restricted to certain groups. To the best of our knowledge, a mutation causing epithelial defects similar to those in cattle and horses has not yet been reported in rodents, carnivores, or primates. It would not be surprising if such a mutation should be found in other ungulates, and among these the species in which it is most likely to be seen are sheep and swine. At least one lethal character, muscle contractures, is known to occur in cattle,[4] sheep,[8] and swine,[3] and to be caused in each by a simple recessive autosomal mutation.

Discussion

The procedures for eliminating any undesirable mutation of this sort from a herd, stud, flock, or kennel of domestic

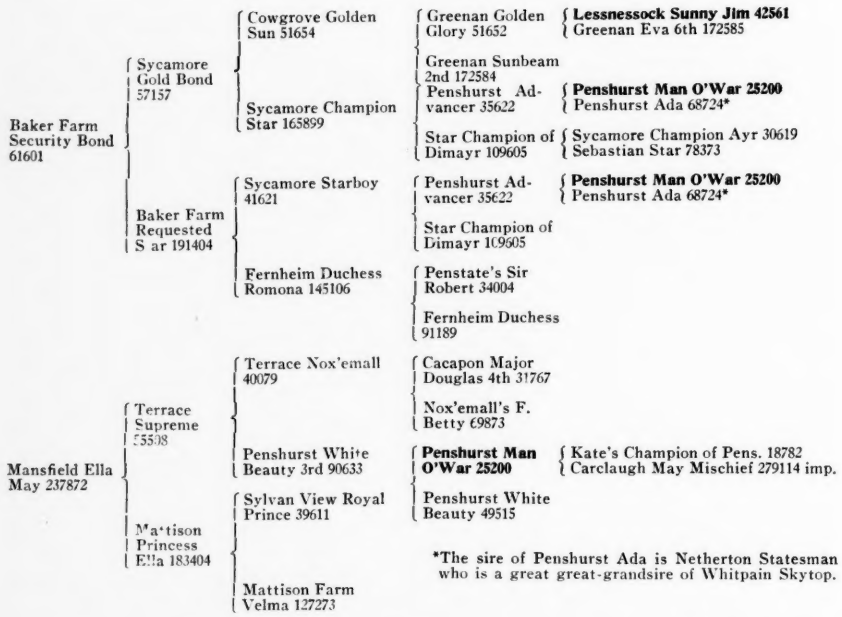
Baker Farm Security Bond 61601
Sycamore Gold Bond 57157
Cowgrove Golden Sun 51654
Greenan Golden Glory 51652
Lessnessock Sunny Jim 42561
Greenan Eva 6th 172585
Greenan Sunbeam 2nd 172584
Sycamore Champion Star 165899
Penshurst Advancer 35622
Penshurst Man O'War 25200
Penshurst Ada 68724*
Star Champion of Dimayr 109605
Sycamore Champion Ayr 30619
Sebastian Star 78373
Baker Farm Requested Sar 191404
Sycamore Starboy 41621
Penshurst Advancer 35622
Penshurst Man O'War 25200
Penshurst Ada 68724*
Star Champion of Dimayr 109605
Fernheim Duchess Romona 145106
Penstate's Sir Robert 34004
Fernheim Duchess 91189
Mansfield Ella May 237872
Terrace Supreme 75508
Terrace Nox'emall 40079
Cacapon Major Douglas 4th 31767
Nox'emall's F. Betty 69873
Penshurst White Beauty 3rd 90633
Penshurst Man O'War 25200
Kate's Champion of Pens. 18782
Carclaugh May Mischief 279114 imp.
Mattison Princess Ella 183404
Sylvan View Royal Prince 39611
Penshurst White Beauty 49515
Mattison Farm Velma 127273
*The sire of Penshurst Ada is Netherton Statesman who is a great great-grandsire of Whitpain Skytop.

CHART II. ***Ancestry of Mansfield May's Augie.*** **This Ayrshire bull carried the gene for epithelial defects. Individuals in bold face type appear also in the pedigree of Whitpain Skytop (Chart I).**

animals have been described so often that their repetition here should be unnecessary.

There is some point, however, in emphasizing the fact that special precautions against widespread dissemination of an undesirable gene seem warranted in these days, when, by artificial insemination, one bull may sire several hundred calves in a year, and these in different herds to the number of several score. Presumably persons selecting sires for artificial insemination do try to avoid those that may be suspected, from their pedigrees, of carrying some highly undesirable gene like that under discussion. If such a suspect is particularly desirable because of his potentialities as a transmitter of high productivity, it would seem wise to prove him to be free of the gene before he is extensively used. If cows heterozygous for the defect are known, these would be the best for such tests. Otherwise, the risk could be eliminated soonest by including among the first females to which the sire is bred a number of his own full sisters, half sisters, and other near relatives. Some of these might be expected to carry any undesirable gene that the prospective sire has, and hence to show the defect in their offspring.

It is to be hoped that Ayrshire breeders who get calves with these skin defects will inform the office of their association so that enough data will accumulate to reveal some of the animals that have carried the gene. Once these are known, it will be evident in what families there is the greatest risk of finding the mutation, and which are absolved of any responsibility.

It is quite possible that this defect may not be considered a serious one by some breeders. This is especially so if the abnormalities are no more severe in other Ayrshire herds than in the one here considered. Since all of the calves survived to an age at which they could be sold for veal, the loss was small compared

with that in Holstein-Friesians. However, in purebred herds the loss of any potential breeder would seem undesirable and not compensated for by the small amount received for a veal calf.

Summary

Four calves from one sire and from related dams showed at birth raw areas on the knees and on the distal extremities of all four limbs just above the hoofs and, to a lesser degree, on the muzzle. The mucosa was lacking under the tongue in the one calf examined in detail, and another had lesions on the inner surface of the ears.

The defect is apparently caused by a simple, recessive, autosomal mutation. Two purebred registered Ayrshire bulls were found to carry the causative gene and their pedigrees are given.

Similarities and differences between this abnormality in Ayrshires and comparable ones in Holstein-Friesians and Jerseys are considered.

The importance is stressed of guarding against widespread dissemination of such undesirable genes through the use for artificial insemination of bulls heterozygous for the defect.

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To Rebuild the Jackson Memorial Laboratory

AN Emergency Committee of members of Congress, college presidents, and business and professional leaders has been organized to help rebuild the Roscoe B. Jackson Memorial Laboratory, world cancer research center destroyed by the Bar Harbor forest fire last October, it was announced recently by Dr. Clarence C. Little, Chairman of the Board of Trustees of the Laboratory. Dr. Little stated that although the Committee will not conduct a huge public drive, it will concentrate its efforts starting May first upon raising a million and a half dollars immediately needed for reconstruction of the Laboratory and its maintenance for the next five years. Jackson Laboratory is not endowed.

The National Cancer Institute, the American Association for Cancer Research, and many other scientific organizations have officially revealed that research toward the cure of cancer has been dangerously curtailed throughout the world, due to the tragic destruction of Jackson Laboratory, Dr. Little said. More than 150 of this country's major cancer research laboratories depend upon Jackson Laboratory for its inbred strains of mice, raised by the hundreds of thousands and recorded, that are the backbone of cancer research.

"GO CLIMB A FAMILY TREE" DEPARTMENT

The broad outline of the evolutionary emergence of the human species is no longer a matter of controversy. This is true even though many of the evolutionary steps which link humankind with his closest cousins in the tree of life have not yet been catalogued. Hence the publication of a "genetic analysis of existing anthropological and palaeontological data" should arouse considerable interest, and might be a valuable adjunct to foster popular understanding.

Unfortunately, the book under review gives the impression of being a tract in support of a particular point of view rather than a survey and appraisal of current knowledge. The main conclusion of the author, that the human species is uniquely polyphyletic is, if true, astonishing indeed. Even if this claim is discredited, the book is so admirably adapted to certain sinister purposes that it will undoubtedly become a primer of racism and fascist reactionism. For that reason it is very important to have in one place an evaluation of Gates' argument by competent experts in the fields of anthropology and of genetics. Hence we are pleased to be able to present an appraisal of Human Ancestry *by distinguished spokesmen in both these fields.*—EDITOR.

I

A Botanist Explores Our Ancestors

GENETIC interpretations are a current vogue in physical anthropology. Not only are vast historical reconstructions, such as the peopling of America, being made on this basis, but even the variations in human skeletal remains are being analyzed in terms of "putative genes." Thus it was a timely and natural step for Prof. Gates to bring out this sequel* to his encyclopedic *Human Genetics* (1946). As a general biologist and the author of several books on human genetics, Prof. Gates brings, as Prof. Hooton points out in his unusually humorless foreword, "a fresh and different outlook . . .[on] the taxonomy . . . of the various fossil and existing types of man." If, in addition, Prof. Gates had brought to his task a more critical outlook, the result of his effort would have been more useful.

A simple organizational device is used to tie together a compilation of summaries. The author maintains that evolutionary parallelisms "occur plentifully in whatever direction we look"; and "that there have been multiple centers of man's evolution." After demonstrating the principle of parallel evolution in the biological world in general (30 pp.), special attention is given to the primates below man (33 pp.), to fossil man up to the Neanderthal stage (40 pp.) and then to five local lines of modern human evolution: a) in Australia (21 pp.), b) in Africa (69 pp.), c) in Europe (37 pp.), d) in America (60 pp.), and e) in the Pacific islands (24 pp.). Stuck in without clear reference to this scheme is a section on "Head shapes and their inheritance" (24 pp.). Two concluding sections, "Speciation in primates" (21 pp.) and "Paleontology, speciation and sterility" (26 pp.), argue one of the problems that grows out of the concept of local human evolution, namely, that the major human groups should have the taxonomic rank of species rather than of races. References are listed at the end of each chapter and when to-

*GATES, R. RUGGLES. *Human Ancestry from a Genetical Point of View.* Pp. 422. Price $7.50. Harvard Univ. Press, Cambridge, Mass., 1948. (With a foreword by Earnest Hooton.)

talled, without excluding repetitions, amount to about 650.

Folk-Flowers

Prof. Gates' botanical background asserts itself early in the book to give a "new look" to the diagrams illustrating the lines of primate and human descent. In his hands the traditional family trees become unbelievably productive flowering shrubs. Even with no more than a garden knowledge of botany one can venture to identify some of the blossoms: the gibbon and Nordic are roses, the Alpine a lily, the Hottentot a poppy, the Australian a fragrant lilac, and the chimpanzee a tulip—and all on one plant! It is portentous for the Nordic-Alpine sprig of *Homo caucasicus* that, unlike the rest, it has been cut off or has its roots enclosed in a Victorian-style vase labelled *Eoanthropus*. Such whimsy characterizes many of the author's interpretations.

The reviewer is an anthropologist with no more training in genetics than in botany, so he is not in a position to judge Prof. Gates' views on these subjects. Nevertheless, he is left with a further feeling of skepticism after reading some of the genetic interpretations of human groups, and especially of human skeletal remains; as for example, when it is reported that a gene represents "the increased cranial size and decreased facial size, which constitute the main features of pedomorphism" (p. 173). I should like to have more assurance, too, that it is good genetical practice to speak of "primitive genes" (p. 153) and "Negro genes" (p. 175); and that I am not being ribbed when I read that "the gerontomorphic Armenoid genes are linked with the Boskop type to the male sex, while the pedomorphic Mediterranean and Mongoloid genes are linked with the Bush type to the female sex" (p. 222). Also, I am puzzled to reconcile the numerous identifications of hybrid skull types in Africa with the statement that in Egypt "intercrossing of [5] types through 7000 years has produced no blend, but instead the original racial types continue to reappear as the result of genetic segregation and recombination of the numerous genes for skull shape involved" (p. 139). And to top it all off, any assurance I might get from Prof. Gates' confident genetic interpretations is dispelled when I find him accepting flattened occiputs in Europe as evidence of hybridization and then following this up with the statement that the flattening is probably artificial (p. 363).

"What Every Anthropologist Knows"

Perhaps my skepticism of the genetics displayed in this book is intensified by the uncritical and careless handling both of the anthropological data and of the opinions of anthropologists. Prof. Gates is inclined to generalize on the unanimity of anthropological opinion. He says on p. 4 that "the majority of anthropologists recognize" and on p. 10 that "Anthropologists now recognize that there have been different centers of human evolution, so that the main surviving races have arisen from different ancestors in widely separated areas." Elsewhere (p. 6, for example), it is "accepted by all anthropologists" that one line of evolution runs from Pithecanthropus to the Australian aborigines, another from Africanthropus to the Hottentots, and still another from Sinanthropus to the American Indians. These are tentative reconstructions advanced mainly by Keith and Weidenreich on the basis of the morphological characters of the few fossil skulls thus far found. Many anthropologists expect that new finds will change this picture. Indeed, the new Australopithecine finds in South Africa, which the author was just able to squeeze in, are already causing a shift in ideas.

In addition to exaggerating the accord in anthropological thinking, Prof. Gates is inclined to make the anthropological data seem more favorable to his thesis than they really are. Thus in the chapter on the American Indians, the field in which the reviewer is best informed, he stresses the primitive characteristics of skeletal remains that are putatively early. For example, he says "it is significant that

many of them are described [by Hrdlička] as 'Neanderthaloid' or having other peculiar features" (p. 288). And again, "Hrdlička (1907) states that there were thirty-six Indian skulls in the National Museum having pronounced superciliary ridges and a low forehead. . . . This indicates that the Neanderthaloid type was a definite one, differing in several respects from other Indians but no doubt intercrossing with them" (p. 289). This is a complete distortion of Hrdlička's views, or for that matter of the views of most anthropologists who have handled much Indian skeletal material. Big brow ridges are a characteristic of the male sex, they occur sporadically even today, and should not be the basis for constituting a type. I have not seen any prehistoric skulls from America that I would call anything other than Indian or Eskimo.

Tracking the Indian

Much of the chapter on the American Indian is concerned with the evidence of man's early arrival on this continent. The general reader doubtless is interested in this, but it is not the material on human ancestry with which genetics deals. Aside from being irrelevant and poorly selected, the record is incompletely reported. Often in the early days the findings of human bones under conditions suggesting antiquity were so poorly observed or now appear so absurd that no one pays much attention to them. Yet here the implication usually is that they are still generally accepted.

The following quotation from this same chapter gives an idea of the involved style and illogical arrangement that is all too common:

> It was concluded [by whom?] that man reached Florida before the mammoth and mastodon became extinct, since their bones were in the same layer as the human bones and artifacts, but Hrdlička concluded [when and where?] that they [the human bones] are physically indistinguishable from the modern Indian [their bones, of course]. A recent reconstruction of the skull fragments by Stewart (1946) shows that it [the Melbourne skull] was not brachycephalic, as Hrdlička thought, but dolichocephalic like the Vero skull, hence conforming to the Paleo-Indian type. The age was regarded [by whom?] as early post-Pleistocene, antedating the Mound-builders [naturally!]. Further digging [where?] in 1926 (Gidley, 1927) followed a different plan. . . [different? Well, reader, maybe you're confused too!] (p. 294)

And here is a whole paragraph of non sequiturs:

> The more recent developments of Pueblo pottery and agriculture in the Southwest are being definitely dated by the tree-ring method (Bryan, 1942) [he is a geologist and not a dendrochronologist]. There were probably three cycles of erosion and alluviation due to climatic changes, the last erosion period being about A.D. 1100-1400 [here we have Bryan]. The growth of Mayan civilization in Yucatan, mainly within the Christian period [that is, somewhere between A.D. 1 and 1948] is ably described by Morley (1946) [well, what's it got to do with genetics anyway?].

Prof. Gates is just as careless in his handling of the race-species question. Throughout the text he uses the term "race" almost to the exclusion of "species" in speaking of the major groups of mankind. Yet in the end he argues for their status as separate species. This seems to negate the purpose of the last two chapters and to bear out Darwin's assertion that "the term 'sub-species' might be used with propriety. But from long habit the term 'race' will perhaps always be employed." Today this whole matter has unfortunate political connotations which would only be intensified by the adoption of the term "species" with its implications of still greater taxonomic differences.

Prof. Gates had an opportunity, in the reviewer's opinion, to perform a real service by passing judgment upon, and extending, the genetic interpretations of anthropological data which are accumu-

lating in the literature. Instead, he has shown a lamentable lack of critical insight into the subject and has simply compiled an odd assortment of anthropological summaries and coupled them with interpretations that are often absurd.* The best that can be said of his effort, and this only echoes Prof. Hooton's faint praise, is that even such a compilation is useful for reference.

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II

Cashiering Homo sapiens—A Geneticist's View

THE declared purpose of this book is "to examine the facts of race in their anthropological and paleontological aspects." This statement hardly prepares the reader for the startling conclusion announced on pp. 366-367, that mankind as a single species is just "a false perspective," and that a collection of precisely five separate and distinct species is involved. The five are duly given the scientific names of *Homo australicus, H. capensis, H. africanus, H. mongoloideus,* and *H. caucasicus.* The old fashioned name *Homo sapiens* proposed by Linnaeus is, in defiance of the internationally accepted Rules of Nomenclature, thrown overboard, evidently because it represents an undeserved compliment. As an afterthought, the author permits this name to be retained only as "a super species, including all living species, if desired."

The Species Concept

Lest some readers dismiss the whole matter as just another nomenclatorial wrangle, the author solemnly warns us: "Disinclination to cross with widely different types is unfortunately a condition which has never developed completely in modern man, although as in animals, preference for a mate of similar type is quite general in mankind. If it were universal, as in animals, then the frequently unhappy combinations arising from crosses between different human species would never occur." Just what are the dire consequences of this strange omission on the part of Mother Nature, we are not told. How different are the "widely different types" between which the disinclination to mate is allegedly universal is not stated either. In the absence of any evidence on which these pronouncements are supposed to be founded, one has no choice but to dismiss the whole argument as a fallacy.

Professor Gates ascribes to Ernst Mayr and to this reviewer the untenable notion of "intersterility [as] an absolute criterion of species," which neither of us ever held, and then proceeds at considerable length to demolish that notion. It is, however, a pity that Professor Gates has overlooked the view accepted by many biologists that species are reproductively isolated populations. For it is crystal clear that mankind, *Homo sapiens,* is not broken in five, or in any other number of reproductively isolated populations.

The body of the book is used to prepare the bomb intended to shatter the *Homo sapiens.* The author says correctly that "anthropologists now recognize that there have been different centers of human evolution," but he gives a misleading accent when he continues "that the main surviving races have arisen from different ancestors in widely separated areas," and he is wide of the mark when he maintains that "We recognize different species, and even genera, of man coexisting in Pleistocene times and giving rise to such different types as the Australian, the Bushman,

*At the risk of seeming to place too much emphasis on minor faults, I should like to call attention also to some evidence of editorial carelessness. The last three credit lines for illustrations (p. vii) are wrong. The introductory sentence to chapter 6 was not corrected to refer to chapter 5 instead of to 4. There is an abrupt change of subject without indication at the bottom of p. 139, at the top of p. 209, and at the bottom of p. 253.

and the Caucasoid from independent lines of descent." It has indeed been shown by paleoanthropologists, principally by Weidenreich whose work is strangely slighted by Gates, that some fossil humans and prehumans share certain traits with the human races which now reside near to the regions where the respective fossils are found. However, this evidence contradicts rather than confirms, Gates' views. As pointed out by Weidenreich, our human and prehuman ancestors formed a single species widely distributed over the face of the earth, and differentiated into geographic races, just as modern *Homo sapiens* is. Some of these ancient races have evolved into the modern ones. The important point is that, in a single species, gene mutations and gene combinations formed in a part of the species population may, if favored by selection, spread to other parts and eventually to the species as a whole. This permits evolutionary advances attained in different geographic "centers" to become the property of the entire species, which thus evolves as a body. It is the author's mistaken notion that the races of prehistoric man represented distinct species or even genera, which confuses his thinking and leads to his bizarre conclusions. The paleoanthropologists' habit of giving generic and specific names to every fragment of old bone found in a new part of the world, does not transform the fossil races into distinct species and genera, any more than Gates' species names attached to living human races make them biologically valid species.

Which Parallels What?

By supposing that human races (Gates' "species") arose independently from different species of anthropoids a quite needless puzzle is created: what caused these different species to become so very nearly human that everybody but Professor Gates includes them in a single species, *Homo sapiens*? The solution of the puzzle is declared to be the "principle of parallel evolution." Different species of prehumans, in different places and at different times, have, impelled by this powerful principle, evolved into human (or subhuman?) beings. Now, paleontologists are familiar with phenomena of evolutionary parallelisms and "trends" in diverse groups of organisms; the pertinent evidence has recently been discussed by Simpson, who argued convincingly that these phenomena are likely to arise as a result of analogous action of natural selection in different phylogenetic lines. Professor Gates prefers to explain parallel evolution by parallel mutation. Clearly, parallel evolution is due to parallel evolution.

Perhaps one of the most surprising things about the book under review, is that such a leader of American anthropology as Professor E. Hooton wrote a foreword to it, although he is at pains to disclaim any responsibility for the strange notions presented in the book.

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Graduate Study at Jackson Laboratory

A PROGRAM of graduate study has been established at the Roscoe B. Jackson Memorial Laboratory at Bar Harbor, Maine. This program will be developed in cooperation with leading graduate schools and is designed to make available to qualified candidates for the doctor's degree the laboratory's genetically unique stocks of mice, rabbits and dogs. Students must satisfy residence and course requirements of the graduate school of their choice, and must be sponsored in research by a member of the Jackson Laboratory staff. Current research at the laboratory centers on the relation of genetics to normal and abnormal growth processes and to the development of social behavior. Some part-time assistantships are available. Inquiries should be addressed to Graduate Study Committee, Roscoe B. Jackson Memorial Laboratory, Box 78, Bar Harbor, Maine.

FROST HARDINESS IN TOMATO SPECIES

RALPH E. LINCOLN*

IN the fall of 1946, frost hardiness of several accessions of *Lycopersicon peruvianum* was noted in field plantings near Lafayette, Indiana.† Since it will be impossible for the author to make observations on this type of material in the future, it seems desirable to record the observations made to date.

Two fields of nine acres each had been planted to the breeding stocks used by the Department of Botany and Plant Pathology. A block of species material was planted in each of these fields. Each block contained representatives of *L. esculentum, L. pimpinellifolium, L. hirsutum, L. hirsutum* var. *glabratum, L. glandulosum* and *L. peruvianum, L. peruvianum* var. *dentatum* and *L. peruvianum* var. *humifusum,* and hybrids between several *L. hirsutum* accessions and *L. esculentum.* In one field this block of material was at the west edge of the field on a very slight elevation of about 18 inches. In the second field this block was on the lowest ground in the center of the field. The difference in elevation between the highest point and lowest point of this field was about 48 inches. In each field this block of special material had plantings on three sides consisting of tomatoes of various breeding background including crosses between three species, *L. esculentum, L. pimpinellifolium* and *L. hirsutum.* Nine plant rows of each accession were planted, and plants were spaced five feet apart both within and between the row.

On October 1st a frost occurred that killed the bulk of the plants in each field. The following accessions, all of the species *L. peruvianum,* remained green and uninjured except for an occasional branch tip or leaf: *L. peruvianum* P.I. 126926, 126928, 126929, 126930, 126844, 126945, 126946, 128653, 128654, and 128656; *L. peruvianum* var. *dentatum* P.I. 126935, 128645, 128647, 128648, 128650, 128651, 128652, 128655, 128660, 128661, and 128663; and *L. peruvianum* var. *humifusum* P.I. 126829. No temperature records were kept for these fields. However, the official record for Lafayette was 37°F and for Delphi was 36°F. A period of 12 days of fair weather followed, and on October 13th a second frost occurred that killed all plants in the field except those of *L. peruvianum* var. *dentatum* P.I. 128661. The official temperature recorded for Lafayette was 35°F and for Delphi 29°F. This second cold spell lasted for three days. On October 20th, although there was damage to the leaves of this accession, only the branch tips were killed.

In the spring of 1947 tests were made for frost hardiness of seedling plants grown in flats. In three different tests made in refrigerated rooms in which the temperature fluctuated between 28 and 33°F no difference in frost resistance could be demonstrated with seedlings of 20 accessions that included representatives of all the species and botanical varieties of *Lycopersicon* enumerated in the second paragraph above.

Various accessions of the several species had been under the author's observation in 1940, 1941, 1942, 1946, and 1947 without striking differences in frost resistance being observed in any year except 1946. It should be noted that P.I. 128661 is rather unfruitful, in contrast to most *peruvianum* accessions, and frost resistance possibly could be related to unfruitfulness. However, since no frost resistance was noted in the non-fruitful accessions of *L. hirsutum* planted in this block, the degree of fruitfulness probably does not markedly influence frost resistance. According to Muller, col-

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†This report is a contribution from the Purdue University Agricultural Experiment Station, Department of Botany and Plant Pathology, Lafayette, Indiana.

lections of this species, as well as *L. hirsutum,* were made by the Blood and Tremelling expedition at altitudes near 8,000 ft.* It seems reasonable to suppose this species has been exposed to selection for frost resistance in its native habitat much more than have the more tropical species, *L. esculentum* and *L. pimpinellifolium,* and that this highly desirable characteristic could be transferred to *L. esculentum*-like types that would be found in segregating populations derived from the cross between *L. esculentum* and *L. peruvianum.* A number of crosses between these species are available, and several segregating populations could be obtained in which to select for this characteristic. If this character were introduced into commercial varieties, many tomato fields would escape injury from the first killing frost each year and remain productive for the "Indian Summer" period following. If transplants of such resistant varieties proved to be frost resistant, earlier setting would be possible, thereby lengthening the growing season at both the planting and harvest ends. Such varieties should have a wider range of adaptation, higher yield and better average quality than varieties that were not frost resistant.

*Muller, C. H. *A revision of the genus Lycopersicon.* U. S. Dept. of Agric., Mis. Pub. 382. 1940.

Books Received

Gruneberg, Hans. *Animal Genetics and Medicine.* Harper & Brothers. New York. $5.50. A clinical and pathological demonstration to bring contact and collaboration between Animal Genetics and Medicine.

Beach, Frank A. *Hormones and Behavior.* Harper & Brothers, New York. $6.50. A summary of the role which hormones serve in many complex patterns. An analysis of the interacting systems of hormonal and neural mechanisms.

Avery, George S., Jr. and Johnson, Elizabeth B. *Hormones and Horticulture.* McGraw-Hill, New York, 1947. $4.50. Begins with a brief historic sketch of plant hormones. Produces evidence of kinds of hormones that stimulate root-production. Takes up hormone treatment of seeds, hormones and weed control; hormones in prolonging or inducing dormancy.

Fairchild, Henry Pratt. *Race and Nationality.* The Ronald Press Company, New York. $3.00. "A frank discussion of race problems presented in a scientific manner, and a plea for good-will."

Terman, L. H., and Oden, M. H. *The Gifted Child Grows Up.* Stanford University Press, 1947. $6.00. The book is Volume IV in the "Genetic Studies of Genius" series. This is a twenty-five years' follow-up of a superior group. Includes traits of the gifted child, general health and physique, mental health, I. Q. tests. The group is composed of 1,400 subjects.

Groves, E. R. and G. H. *The Contemporary American Family.* J. B. Lippincott Company, New York, 1947. Revised and rewritten from an earlier work, "The American Family," 1934. Traces the development of the family up to the modern American family. Emotional aspects of family life with personality growth and family experience, concluding with a description of the "Successful Family."

Patten, Bradley M. *Human Embryology.* The Blakiston Company, Philadelphia. 1946. $7.00. A textbook on human embryology with each phase of the subject developed to demonstrate its importance in practical medicine.

Samuels, Dr. J. *Endogeneous Endocrinotherapy including The Causal Cure of Cancer.* Holdert & Co., Amsterdam, 1947. "Treating on diagnosis, symptoms, prognosis, therapy." The author's ideas are far from congruent with the concensus of current research and clinical opinion.

Buell, Raymond Leslie. *Liberia: A Century of Survival, 1847-1947.* University of Pennsylvania Press, Philadelphia, 1947. $1.50. A fairly complete diagnosis of the Liberian problem, with chapters on recent economic development, and a rehabilitation program. The author believes new methods of political science should be devised to put the country on its feet and train its people for self-government.

Tomkins, Silvan S. with collaboration of Elizabeth J. Tomkins. *The Thematic Apperception Test.* Grune & Stratton, Inc., New

York. $5.00. A history and development of the TAT with technique of administration—scoring scheme. Diagnosis of personality, social and vocational relationships.

Annual Report of the Smithsonian Institution, Government Printing Office, 1947. $2.25. Operations, expenditures, and condition of the institution for the year ended June 30.

GUTTMACHER, DR. ALAN FRANK. *The Story of Human Birth.* Pelican Books, 1947. Facts of life for expectant mothers and for fathers—and adult readers generally. A reprint of a notable presentation of a technical subject in a manner that is both pleasing and understandable to the lay reader.

BUCHANAN, NORMAN S. and LUTZ, FRIEDRICH A. *Rebuilding the World Economy.* The Twentieth Century Fund, New York. $3.50. America's role in foreign trade and investment. A survey of previous experience and the present situation. Population factors considered in passing.

SCHATKIN, SIDNEY B. *Disputed Paternity Proceedings,* 2nd edition. Matthew Bender & Company, Albany, 1947. The author states that a competently and conscientiously performed blood test is infallible proof of nonpaternity. Includes reference material to late decisions of appellate courts and recent articles on the Rh-Hr blood types that have appeared in scientific journals—but of *C-D-E* not a whisper! Artificial insemination and its effects on the legitimacy of the child are reviewed.

WYMAN, DONALD: *The Arboretums and Botanical Gardens of North America.* Chronica Botanica (10:5/6) $1.50. 1947. This illustrated monograph attempts to show "what the present arboretums and botanical gardens of this country are like, where they are located, methods by which some of them are established. . ." The Introduction states that it is intended that the booklet will be used "in whole or in part as preliminary and supplementary material" for the forthcoming book by Gordon D. Cooper, *Arboretums, Their Aims and Scope,* which was announced for publication in 1947 by the same publisher. The subject of arboretums merits a more extended discussion in these pages, and we are looking forward to a combined review of these two works in the near future.

◆

Trace Elements

ONE of the results of probing ever deeper into the mysteries of the mechanism of living matter is the discovery of the enormous biological activity of exceedingly minute quantities of certain substances. Hormones, bacterial toxins, enzymes, vitamins and genes come immediately to mind. Within recent years has come the realization that certain chemical elements previously regarded as absent, or, if present, existing in living matter in amounts too small to be noticed, do in fact play a very important role in the living organism. These elements are now commonly known as "trace elements" to indicate that although they are found only in incredibly small amounts, they have a profound effect on development. This term incidentally, should not be confused with *tracers* about which so much is now being written in connection with the biological applications of stable and non-stable isotopes.

Professor Stiles of Birmingham University has attempted in this small booklet* to summarize a part of the large literature which has already accumulated about the role which the trace elements play in plants and animals.

Among the elements listed in this book are manganese, zinc, boron, silicon, aluminum, chlorine, copper, columbium, molybdenum, tungsten and gallium, and also fluorine, selenium and iodine.

The author opens his text with a brief historical introduction followed by a discussion of methods for studying micro-nutrient problems, primarily in plants. Then follows a section on trace element deficiency diseases of plants and a chapter on the functions of trace elements in animals. Unfortunately this last part is brief almost to the point of inadequacy, which can be explained perhaps by the fact that the author happens to be a botanist.

Finally, there is a bibliography listing about 400 references where one notes some surprising omissions as, for example, the absence of any mention of the work of E. V. McCollum and his students.

Despite its deficiencies this work serves the useful purpose of drawing attention to these potent substances and to the importance of their environmental influences.

MORRIS C. LEIKIND
Library of Congress

*STILES, WALTER. *Trace Elements in Plants and Animals.* 189 pp. $2.75. Cambridge University Press. Macmillan Co., New York. 1946.

MICROPHTHALMIA IN SWINE

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WHEN microphthalmia appeared among several offspring of a Yorkshire boar, the pedigrees of the blind pigs were searched and test matings were made with a view to clarifying the hereditary nature of the character. The pedigree (Figure 4) summarizes the results of this investigation. It is noteworthy that the affected pigs were all related, even though the blindness occurred on two different farms, that of the Indian Head Experimental Station,* as indicated in the pedigree, and that of the University of Saskatchewan.

Microphthalmia of an hereditary type has been reported in mammals of many types, from mice to men. In many of these cases the defect has had lethal or semi-lethal effects. Phenotypic expression varies from a slight decrease in size of eyes to complete anophthalmia. A recent example of the latter is reported by Ashley,[1] who also summarizes the literature of similar defects insofar as they concern man. Jeffrey[4] reports hereditary microphthalmia in domestic fowl.

Other Instances of Microphthalmia

This defect has been noticed in swine in several parts of the world. In 1933, Hale[3] reported eleven pigs born without eyeballs. He attributed the defect to a lack of Vitamin A in the ration of the sow. Buchanan-Smith *et al.*[2] noted defective individuals and suggested the possibility of an hereditary basis. Lush† has noticed a significantly high incidence of blindness in an inbred line of pigs. Its genetic basis is still unanalyzed but it seems irregular in penetrance and the phenotypic manifestation varies from complete anophthalmia (as examined externally) to the eyes which appear entirely normal but go blind at eight months of age or later.

In the present study the defect was found to vary considerably in its severity. It might be expressed either unilaterally or bilaterally. The size of the eyes varied from individual to individual. In some cases they were large enough to be easily observed upon external examination, but in others the animal seemed quite anophthalmic until it was dissected. None was found that exhibited complete anophthalmia. Only a small proportion of the animals lived to maturity, due to their difficulty in competing for food.

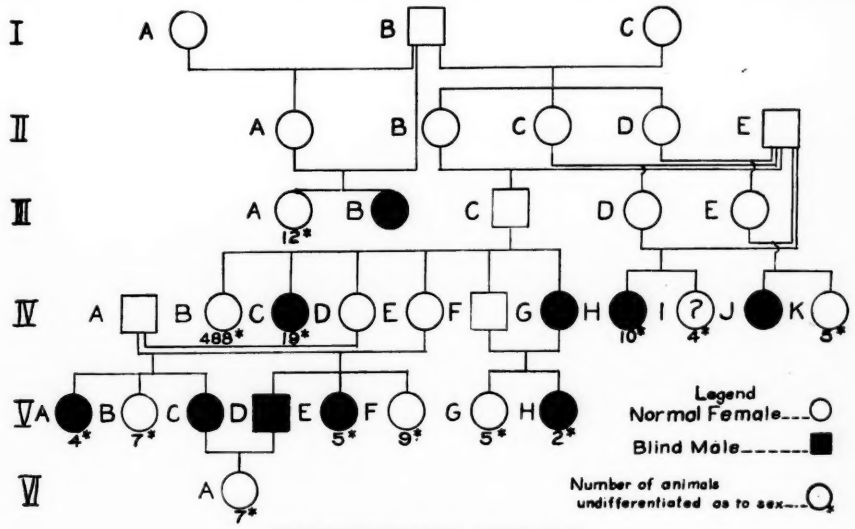
Hale's work made it advisable to check the rations of sows in whose litters microphthalmics appeared. This showed that some of these animals may have lacked vitamin A, but that others, including those at the Indian Head Station, were on rations that were well balanced and which in particular contained adequate amounts of Vitamin A.

A reference to breed was made above. It might be added that all of the animals concerned were pure-bred Yorkshires. Some of them, except for this defect, were animals of exceptional value, which increases the importance of knowing the cause of their defective offspring.

To the information summarized in the pedigree chart (Figure 4) have been added the results of two test matings. They are the mating of (1) the normal boar, IV-F to his blind half-sister, IV-G, which resulted in five normal and two blind pigs; and (2) blind boar, V-D to his blind half-sister, V-C. From the latter mating seven pigs were born and all of them had normal eyes. Had this been an isolated case the defect might well have been attributed to the fact that

*This information by personal communication from W. W. Cram of the Indian Head Experimental Station.

†Lush, J. L., Personal communication.



MICROPHTHALMIA PEDIGREE

Figure 4

This pedigree shows the relationships between the microphthalmic pigs studied. Animals I—A,B,C,; II—A,C,D,E; III—A,B,D,E; and IV—H,I,J,K; were at the Indian Head Experimental Station of the Dominion Deartment of Agriculture, Indian Head, Sask. The remainder were on the farm of the University of Saskatchewan, Saskatoon, Sask. Note that in spite of the high incidence of microphthalmia in the strain, some blind pigs when mated had all normal offspring, and that some normal matings produced mainly blind pigs.

during pregnancy sows IV-E and IV-F were on deficient diets, but many of the other sows were on satisfactory rations. For example, III-D and III-E received both cod liver oil and alfalfa meal during pregnancy and while nursing.

Genetic Basis Uncertain

An examination of the pedigree shows that in each generation, from III on, blind pigs appeared. It should be noted that in some instances, as in the mating of III-D to II-E, large numbers of defective animals appeared in the litters of normal animals, and that, in contrast, two blind individuals gave rise to nothing but normal offspring in the mating described above. These matings indicate that the defect is probably not of a simple dominant or recessive type. If the defect were caused by a dominant gene with a low penetrance all of the results could be adequately explained. If this low penetrance were caused by a recessive modifier many of the results would be explainable. We might let the dominant factor for microphthalmia be *Ey* and the modifying gene be *m*. In the mating of II-E to III-D, the former may have been of the genotype *eyeyMM*, and the latter *EyEymm*. In their litter there were ten pigs which were blind and four which were possibly blind. If these uncertain types were blind the parents produced the proportions to be expected. In the mating of V-D to V-C the genotype must have been *EyeyMm* in each case. If this type were so we would expect nine microphthalmic to seven normal individuals. Using the binomial theorem we would expect seven pigs in only three such litters out of 1000. Thus the chance of this occurring is not very high and this mating is a strong argument against the possibility of a simple recessive modifier. The modification of the ratios may then be due to other genetic factors or to environmental factors or to a combination of both.

Conclusion

It seems probable that the inheritance of microphthalmia in this line of swine is primarily due to the effect of a dominant gene with a low penetrance. This low penetrance may depend upon (a) environmental factors, (b) genetic factors, (c) a combination of both, and in this last event the recessive modifier might be more suitably utilized. More data would be necessary to determine the cause of the modification with any degree of certainty.

It is significant that boar II-E was not used in further breeding work because of the appearance of this defect. He was an outstanding boar, having qualified on the Canadian Advanced Registry program for swine. An examination of the pedigree indicates that it is now highly probably that he did not carry factors for the defect. This indicates the necessity for large genetic institutions capable of testing outstanding boars thoroughly, as well as analysing any defects which occur. Such institutes could analyze these much more readily than can smaller institutes such as we have today. In this instance early research might have saved an excellent animal for future use. The herds involved were not large enough to carry out proper tests in a short time.*

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*The writer would like to acknowledge the co-operation of the Animal Husbandry Department of the University of Saskatchewan and the assistance and advice of many persons. Special thanks are due to Professor Forshaw, now at the Ontario Agricultural College, and to Dr. T. J. Arnason of the Biology Department of the University of Saskatchewan.

Exit E. S. R.

THE Experiment Station Record is no more. Without fanfare, tears, or valediction, Agriculture's staid, omniscient and compendious old lady expired of federal disease (*Gdorsobius taberi*) on the threshold on her sixtieth year.

When the morning's mail would come, no eager fingers trembled impatiently to leaf through her familiar pages. Not until the last pennysaver had been opened and cursorily scanned en route to the waste basket, did her turn come. And then all she could expect was to be de-wrappered, riffled, and flung unceremoniously onto the mounting pile in the corner. There, with her knack of always seeming dusty on arrival, the latest issue would blend with the earliest in one grey amorphous mound.

But inevitably the moment would come. "What's the latest on *Boophilus australis?*" or, "Is it true that the pickleworm is an enemy of curcubits?" or, "Didn't V. V. Sreeramamurthy have something to say about that?" Then a flip through the E. S. R. index would unearth chapter and verse, and in a trice the elusive datum would be pinned down.

Many an office will be the neater for the demise of the good grey lady. But in many a cloistered tower of learning, in innumerable quiet corners where facts are sought and recorded, neatness will seem too high a price to pay for the loss of a dependable old friend.

E. S. R.

1889-1948

R. I. P.

LENS RUPTURE

A New Recessive Gene in the House Mouse

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THE condition described in this preliminary report was first observed in an inbred albino strain of mice. The eyes of affected individuals appear normal until, at an average age of five weeks, opaque white areas appear in the proximal region of the eyeball. Preliminary observations indicate that the anomaly is characterized by extrusion of the nucleus of the lens through the lens capsule into the vitreous chamber. The remainder of the ruptured lens is greatly reduced in size, distorted in shape and abnormal in position—it may even pass through the pupil into the anterior chamber.

Crosses between affected individuals produced 213 offspring of which 207 were affected by nine weeks of age (three unilaterally); six offspring (4 ♂ : 2 ♀) remain phenotypically normal at five months. Crosses of affected mice to normal animals from unrelated strains produced 64 offspring, all phenotypically normal at 12 weeks of age. Matings between normal individuals which had one affected and one unaffected parent resulted in 125 offspring of which 30 (17 ♂ : 13 ♀) were affected by nine weeks of age. This is a close approximation to the 3:1 ratio expected if the condition is inherited as a simple recessive.

Crosses of normal individuals which had one affected and one normal parent to affected mice produced 115 mice of which 56 (23 ♂ : 33 ♀) showed the anomaly by nine weeks of age. This is very close to the 1:1 ratio expected on the basis of simple recessive inheritance. No evidence of sex-linkage was found. It is therefore concluded that this condition represents the external manifestation of an autosomal recessive gene showing approximately three per cent overlap at nine weeks of age. It is suggested that the condition be called *lens rupture* and be represented by the symbol *lr*.

HISTORY IS ON WHOSE SIDE?

THE genesis of the phenotypic manifestations we call socio-political attitudes and outlooks is a fascinating though difficult field of study. Among the most interesting case-history guineapigs in this field are the very vocal British communist biologists, J. B. S. Haldane and Joseph Neelham. The essays, addresses and broadcasts which comprise this volume* were delivered by Needham between 1931 and 1942. The subject matter covers a vast area — from the evolutionary implications of the second law of thermodynamics to the relationship of primitive Christianity and Communism, with a long dissertation on the scientific shortcomings of Hitlerism—a subject which events have definitely dated.

The principal message which the book attempts to convey, and which is reflected in the title, is that the second law of thermodynamics and primitive Christianity are all parts of a clear and consistent orthogenetic evolutionary trend titillated by a series of revolutionary emergents. Among the greatest of these—at least to us humans—is the emergence of

*Needham, Joseph, F. R. S. *History is on Our Side.* Pp. 226. $2.75. Macmillan, 1947.

human society. An important secondary adaptation in social organization was the emergence of primitive Christianity. This Needham considers a crucial milestone mainly because in his estimation it represents the first organized and effective enunciation of the communist principle. To the concept of man's spiritual equality before God was added Christ's unique conception of man's social equality before men. This idea — common enough to 20th century man, in theory if not in practice — is at the root of ideal Christianity as of ideal socialism.

Thus primitive Christians, we are told, were primitive communists, and it was not until the Middle Ages that the organized church was able to get this "unfortunate" trend under theocratic control. Today primitive communist principles have so successfully been purged from the Christian churches that Needham considers the church to be completely off the evolutionary beam. Non-communists agree surely with the part of this thesis which holds that there is a vast chasm between the modern official Christian creed and that of the early communicants. Needham does an excellent job in this part of his discussion.

Many readers will be astonished and shocked to learn that the true heirs of the spiritual robes of Jesus Christ live in the Kremlin. In short, we are asked to accept the remarkable assumption that Christ's primitive communism is comparable to if not actually identical with Stalin's Soviet variety. Surely a supreme expression of faith must be invoked to be able to accept the Kremlin, the politburo and the ramified power network thus controlled, as being "primitive" in either the Christian or the communist sense.

The book is fascinating reading, but the reviewer suggests that the reader maintain a wary eye for the casuistry which seems to the reviewer to clutter so much of this discussion. "Primitive Christianity" and "primitive communism" are attitudes and ways of life that any social-minded person must sympathize with. The peculiar mental myopia which can see the mote in current church dogma and practice but which fails to detect anything but purity and light in the Party Line, is so astounding as to demand our puzzled admiration.

Very likely Needham is right — that history *is* on the side of "primitive Christianity" and "primitive communism." At the moment the stock of both these philosophies is so low as to be completely off the board. That this is so is no compliment to the existing organizational status of the human race. This reviewer suspects that the surest way to hold back the dawn of a better world is to follow the path Needham advocates. Having run the gamut of non-primitive Christianity for a millenium, we are now urged to run the parallel gamut of non-primitive communism—which is simply the old incubus of authoritarian totalitarianism in a new disguise. If history is going to be on anybody's side we will have to do a great deal better than that. Needham's smug conviction that his curious rationalizations have put him on the side of the angels seems to this reviewer to be a notable example of how faulty identification can reduce a brilliant intellect to a near-gibberish of special pleading. This demands that we see the varied greys of a mixed and complex multi-ordinality only as glaring blacks and whites.

—R. C.

✦

"I GREATLY FEAR . . ."

THE perpetrators of the Condon scandal must be covered with well-earned dismay to discover that their headline hunting has bagged them a genuine cause celebre. *To the publicity-wise Thomas Committee, the Director of the Bureau of Standards must have looked for all the world like a sitting duck. But they forgot*

that buckshot scatters; that when you violate an individual you outrage a principle. A clear-eyed citizenry has greeted this irresponsible myopia with a clamor that must hearten all lovers of justice. The echo of the Thomas blunderbuss continues to reverberate in wave after wave of protest. Perhaps the high point in the public's angry reaction was reached in a testimonial dinner held recently in New York by Dr. Condon's scientific colleagues. The excerpt from Dr. Harold C. Urey's speech reproduced below indicates by painfully apt analogy the grave practical consequences to society and to science of such demagogic defamation.—ED.

Recently I have observed a piece of apparatus of a type previously constructed, which was being built with the objective of securing a higher precision of measurements than had ever been secured before, by approximately a factor of ten. Several clever young men have worked on this instrument, trying to improve all the various parts and to secure the best possible operation of each part. Slowly, as time has gone by the instrument performs occasionally with the precision required; at a later time, it operates for longer periods of time with that precision, and finally, it is possible to make the instrument perform with this precision except for brief periods of repair. Now if the young men working on these things were less careful by a small amount; if they were less persistent in a small degree, if they were less ingenious than they are, it could easily happen that the instrument would *not* improve with time; and, in fact, it might get worse. Thus at the edge of scientific accomplishment the last increment of ability and skill makes all the difference between success and failure. Similar examples could be drawn over and over again. I wish only to say that there is an enormous premium in successful scientific work for the person of the highest ability.

These individuals, both in science and in other fields, who have this last increment of ability or determination (which is very important) have made and are making an enormous contribution to the intellectual and material life of our nation and of the civilized world. They are making contributions far out of proportion of their numbers or their monetary incomes.

The German Purge

Now this kind of scientific activity can be completely destroyed, and I wish to bring to your attention two illustrations of such destruction. Hitler had a maniac hatred of the Jews, and any Jewish scientists in Germany before the war lost their positions and left the country. Hitler's hatred extended so far that even the works of these men were banned. For example, the theory of relativity could not be taught in Germany because it was proposed by Albert Einstein. These German scientists, as we know, in many cases came to the United States, and worked in one capacity or another on the atomic bomb. Germany's loss was our gain. A great deal of technical skill remained in Germany, but in many cases it was very badly used. In spite of handicaps, important technical developments in support of the German war effort were made. The Germans developed the high-speed submarine—just slightly too late to win the war for them. They did succeed with the V-1 and the V-2—just slightly too late to win the war. They also developed the high-speed fighter, armed with rockets which are so deadly to bombers, but this was too late to win the war. I think it is possible that if Hitler had been a different man in some ways, and if he had been able to secure the help of his scientific men to the fullest degree, he might have won the war. He destroyed that last increment of scientific ability. Hitler was an ignorant man, and probably if he were living today, he would still not understand what he did in this respect.

The Soviet Purge

Another example of this sort of thing has been recounted to us by Dr. Muller who just in the last few days has been telling me how a Russian charlatan by the name of Lysenko, with the aid of a dictatorial and bureaucratic government, has destroyed the science of genetics in the USSR. Geneticists were accused of violating dialectical materialism, and these accusations, which amounted to flagrant defamation of character of scientists in the USSR, resulted in their arrest, exile to Siberia in some cases, death, or escape from the USSR, until today there is no valid science of heredity in that country. We cannot, of course, say what the bad effects of this will be. One thinks of the loss in improvement of food plants and animals, which might be developed in the hands of men skillful in the science of heredity.

Are We Next?

Scientists can also be driven from work in our government laboratories. Such laboratories have had for many years, and have now, very serious difficulties in several respects. There is the difficulty of lower salaries than are generally paid in Industry and in our better-paid universities. This makes it difficult to recruit for these laboratories, whether at the Bureau of Standards, engaged predominantly in peacetime activities, at military laboratories, or laboratories of the Atomic Energy Commission. In the case of some of these laboratories, the secrecy conditions, although recognized as necessary, are nevertheless annoying. If now we add to these serious handicaps the character assassination by innuendo, I greatly fear that we will not be able to recruit the type of men so badly needed for this work.—HAROLD C. UREY.

"——WHERE ONE GREW BEFORE"

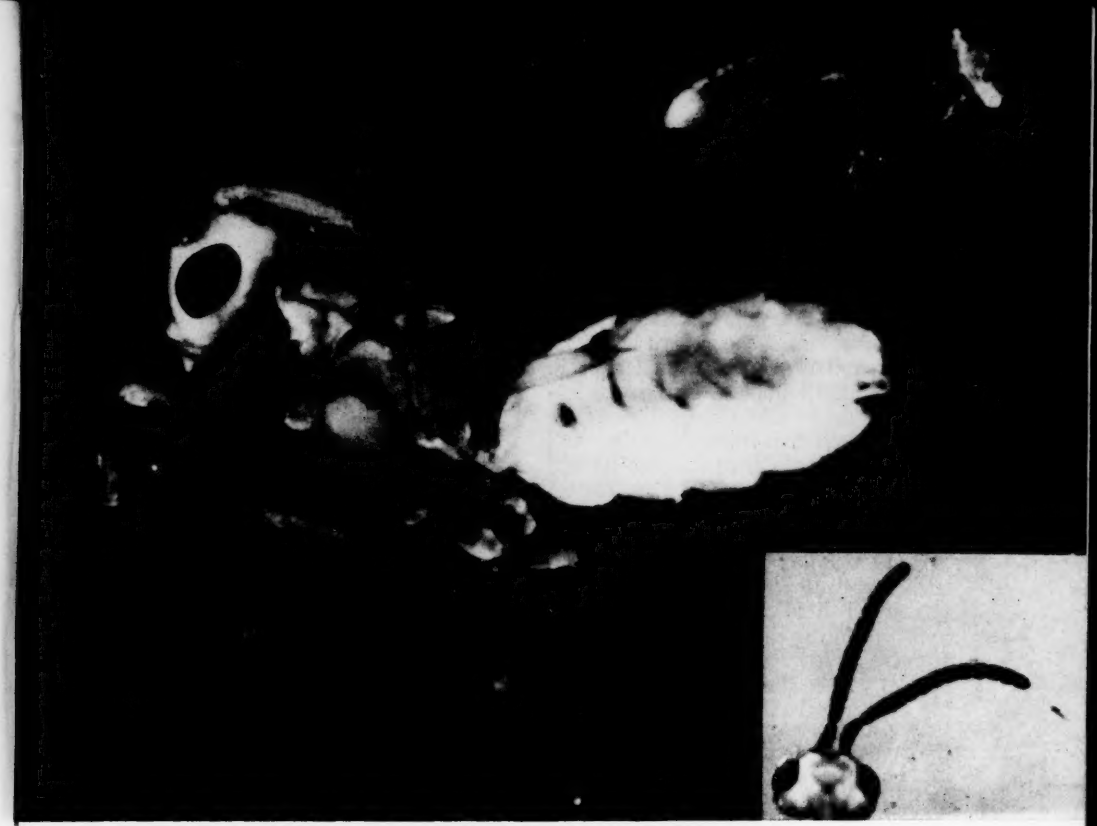
AT the time of the publication of the Genetics Yearbooks of the U. S. Department of Agriculture, about ten years ago, a brief synopsis of the early history of the Department of Agriculture was presented. The story of this greatest of federal research agencies has long been in urgent need of telling, and part of the tale has now been told.* The author began his professional life as a research chemist in the halycon days of Harvey Wiley's battles with the food adulterators. In the intervening years he has metamorphosed into an editor and a notable interpreter of scientific knowledge.

In this book Mr. Harding's main objective is to establish that federal research in agriculture has been a good investment. Anybody even slightly acquainted with the facts will be astonished that this proposition needs to be proved. But it does: not only once, but again and again. As the squeaking wheel gets the grease, so do federal appropriations tend to gravitate toward those activities which squeak in a key calculated to stimulate the congressional ear. And very rarely is the scientific research worker able to cast his voice in the high-pitched "gimme" scream which does command congressional attention. Hence there is a real need for factual folklore for educating congressmen and constituents.

The book is not what its subtitle suggests. It lacks the comprehensive scope of a history. It is a gripping tale of the exciting parts played by *some* U. S. Department of Agriculture scientists in the endless search for fundamental knowledge.

Taken for what it is, the yawning gaps in the story need not be taken seriously. And what is told is well and fascinatingly told.—R. C.

*HARDING, T. SWANN. Two Blades of Grass: A History of Scientific Development in the U. S. Department of Agriculture. University of Oklahoma Press. $3.50.



NO PATTER OF LITTLE FOUR-PAIRED FEET

Figure 5

Leglike antennae are a reproductive misfortune to Habrobracon, for in strange ways this "new look" makes life complicated and futile. Male wasps can't perceive the femininity of the gentler vespine sex without functional antennae, so they are to all intents and purposes sterile. (Nobody has yet figured out how to achieve artificial insemination in ¼-inch long Habrobracon —here shown greatly enlarged.)

LEGLIKE ANTENNAE IN HABROBRACON

IN a certain selected strain of Habrobracon with tapering antennae, *ta*, the terminal segments were in general modified into tarsi. This trait was called antennapedia, *ap*.

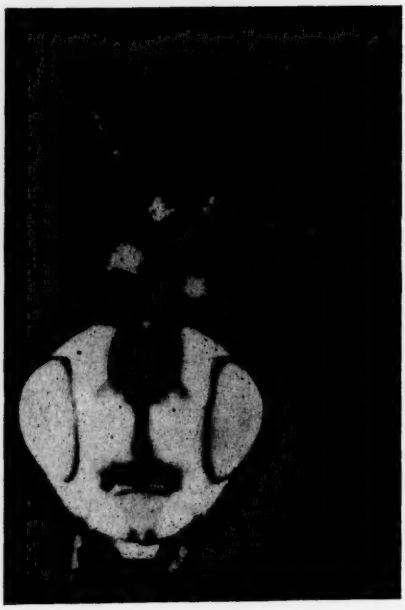
Truly leglike antennae in which almost the entire structure is involved have occurred independently of tapering. Either one or both appendages may be affected. In some cases leglike is obviously due to a mutation since it occurs in about half of the haploid sons of a single female. Because normal antennal sense organs are requisite for perceiving the female, matings have never been obtained with leglike males. Thus far it has happened that the heterozygous mothers of leglike sons have died before the mutants were found. Consequently it has not been possible to perpetuate leglike by crossing the heterozygous females to normal males.

Figure 6 shows the head of a single mutant (?) leglike male (freak 992) which occurred in a white-eyed stock. He has crossed his antennal "knees" over his head. The two basal segments, long scape and small pedicel, are dark in color and of normal antennal form. The scape may be thought of as corresponding to the coxa of the leg, the pedicel to the trochanter, but the latter is not in

this case doubled as is characteristic of the normal trochanters of the legs of these parasitic wasps. The modification is therefore distal to these segments. The two "femora" are dark and slender basally, expanded and yellow distally resembling the femora of the normal legs. The "tibiae" and "tarsi" are also leglike in character, the latter being five-segmented. The tarsal claws are rather small. The left "leg" is in front of the right and the "knees" are bent so that the "tibiae" as well as the "femora" appear crossed.

The female (freak 1005) shown in Figure 5 developed from an x-rayed egg (1050 *r* units) fertilized by an untreated sperm. She is unique in that the proximal half of each antenna is leglike in form and in yellow color, but the first segment is not flattened as much as a normal coxa. The "trochanter" is double as in the true legs and the "femur" is of length, diameter and color normal for a true femur. The succeeding segment, narrow and yellow at the base like a tibia, soon enlarges and blackens resembling an antennal segment distally. The other segments (nine distinct in the left, more or less fused in the right) are antennal in character, being black in color and bearing longitudinal sensory grooves. Since stinging and ovipositing reactions, normally dependent upon antennal sense organs, were lacking, no progeny were obtained. It is, nevertheless, highly probable that the trait was caused by a dominant mutation induced in the egg.

It may be of interest to speculate about the bearing of these leglike antennae on theories of serial homology. Embryologically the antennae are prostomial and are not usually regarded as homologous with the legs. It may be questioned how seriously the student of evolution should take the numerous non-adaptive freak types occurring spontaneously or induced by x-raying. A fifth wing with venation similar to that of the primary occurs in a small percentage of the wasps in a certain stock. Origin is from the suture between the prothorax and mesothorax. Branched legs and branched antennae may also be mentioned. In the realm of teratology it appears that "anything can happen."



HE CROSSES HIS "KNEES" ON TOP OF HIS HEAD

Figure 6

The basal parts of the antennae have developed into typical leg structures. Since such freaks lack normal mating reactions, they leave no offspring, even though sons of heterozygous mothers might be produced in the absence of fertilization.

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FACTORS MODIFYING INHERITANCE OF DOUBLENESS IN THE NASTURTIUM

By S. L. Emsweller and C. O. Blodgett*

THE inheritance of doubleness of the Golden Gleam type in nasturtium (*Tropaeolum majus*) has been reported by Eyster and Burpee[1] to be controlled by a single recessive gene. In a more recent paper Whaley and French[2] have confirmed this.

The present paper presents data which confirm the existence of this basic recessive gene for doubleness in the nasturtium. It is also shown that its expression is complicated by modifying factors.

A nasturtium flower of the single type has five petals and eight anthers. No single-flowering plant was ever observed that deviated from this formula. The individual double flowers on a Golden Gleam plant have a varying number of petals, ranging from six to 15, and from 10 to 13 anthers. Individual Golden Gleam plants may vary in mean number of petals from 9.5 to 10.5. During the course of this investigation, thousands of flowers on Golden Gleam plants have been examined and none had as few as five petals.

Results of Crosses

Hybrids were made between the double variety Golden Gleam and the single varieties Dwarf King Theodore, Dwarf Vesuvius, Dwarf Chameleon, and a climbing variety named Moonlight. Subsequent progenies from self-pollinations of all the parent plants demonstrated that Golden Gleam was homozygous for doubleness and the other varieties for singleness.

All the hybrids secured from crossing double × single and reciprocal were single-flowering. Some were selfed and also backcrossed reciprocally to Golden Gleam. The data are shown in Table I. All plants bearing any flowers with more than five petals were classified as double-flowering. It is seen that doubleness is apparently a simple recessive.

Some plants were grown in a greenhouse during the winter and cuttings of them were transferred to a lathhouse in spring and summer. The mean petal number of each of 27 plants grown in the two environments was secured. It was found that significant differences in doubleness occurred and that 24 of the 27 plants had a higher petal count in the lathhouse than when grown in a greenhouse. Since the environment appeared to have considerable influence on doubleness, subsequent comparisons between plants were made under as uniform growing conditions as possible.

The mean petal number of the double-flowering plants in F_2 and first backcross to Golden Gleam is shown in Table II. The F_2 population was significantly less double than that of the first backcross, and the latter had significantly fewer petals than Golden Gleam. Obviously the degree of doubleness of Golden Gleam was not retrieved in either F_2 or first backcross. Among the F_2 plants, No. 15 had a mean of $5.36 \pm .076$ petals and No. 18 had $8.59 \pm .081$ petals. These differences are significant, and both values are less than the mean for Golden Gleam. The petal-count means for the F_2 plants formed a continuous series from lowest to highest, with significant differences existing between those at the extremes of the range.

Among the plants of the first backcross to Golden Gleam, the mean petal number ranged from $6.87 \pm .319$

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for the least double plant to 9.34 ± .231 for the plant having the highest petal number. Most of these backcross plants were significantly less double than Golden Gleam. Plant 9 and a few others had fully as many petals as Golden Gleam. When plant 9 of the first backcross was again crossed to Golden Gleam the mean petal number was raised to 10.15 ± .240. This is not a significant increase, and continued backcrossing did not affect the degree of doubleness.

Two F_2 plants, Nos. 15 and 18, were self-pollinated and backcrossed to Golden Gleam. The results show that the plant with low petalage gave continued low counts when selfed and when backcrossed to Golden Gleam. The plant with greater number of petals maintained the higher count.

The data presented indicate that inheritance of flower doubleness of the Golden Gleam type in nasturtium is more complex than heretofore suspected. The continuous range of variation from low to high double plants in both F_2 and backcross populations points to the probable presence of a number of genes that modify the expression of the recessive gene for doubleness. These modifiers are introduced with the gametes from the single-flowering parent, and it is probable that two or three modifiers will account for the variation between individual F_2 double plants.

The common failure of many introduced double nasturtiums of other colors to equal the petalage of Golden Gleam is probably to be attributed to the presence of these modifying genes.

TABLE I. Results of crossing double (Golden Gleam) and single nasturtiums.

F_1 hybrids	F_2 progeny			
		Observed	Calculated	Deviation
All single	Single	121	112.5	8.5
	Double	29	37.5	—8.5
		Backcross		
	Single	13	10.5	2.5
	Double	8	10.5	—2.5

TABLE II. Comparison of mean petal number of Golden Gleam (double) with the F_2 and backcrosses to Golden Gleam, derived from originally crossing the double variety with single.

Origin of Plants	Mean Petal Number
G.G. 43/4701*	9.53 ± .029
F_2 29/1352	6.94 ± .040
First backcross 65/1504	8.88 ± .045
First backcross (Plant No. 9) 1/53	9.34 ± .231
First backcross (Plant No. 8) 1/90	6.87 ± .319
Second backcross G.G. × B_1 (Plant No. 1) 3/61	10.15 ± .240
F_2 (Plant No. 15) 1/113	5.36 ± .076
F_2 (Plant No. 15 selfed) 10/424	6.58 ± .001
G.G. × F_2 (Plant No. 15) 1/952	6.23 ± .043
F_2 (Plant No. 18) 1/204	8.59 ± .081
F_2 (Plant No. 18 selfed) 10/519	8.46 ± .060
G.G. × F_2 (Plant No. 18) 10/822	8.58 ± .046

*Number of plants/number of flowers.

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✦

Familial Differences in Fluoride-Inhibited Tooth Decay

Fluoride in the drinking water materially reduces the incidence of tooth decay. The degree of inhibition of caries varies directly with length of residence in the fluoride-water community, those having lived there all their lives showing a higher degree of immunity than those who have moved in from a non-fluoride community. However even among lifetime residents a considerable variation exists. According to Henry Klein in *Public Health Reports* (April 30, 1948), those children "who have the least amount of caries experience have parents showing smaller than average amounts of experience with dental disease while the children who have the most caries experience (in spite of their residence in a fluoride environment) are the ones whose parents have had more than average amounts of such experience. Hence a powerful familial factor in dental caries susceptibility is evident even in an area where fluoride is available in the community water supplies. It follows therefore, that variation exists among different children in their response to the caries-inhibitory effects of fluoride water. Certain children are protected more, others less, and this variation is associated, among other factors, with familial susceptibility."

THE HEREDITARY NATURE OF FOOD-ALLERGY

Notes for a Study in Human Genetics

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THE purpose of this note is to bring to the notice of geneticists a large body of observations upon a newly defined constitutional disease which have been published only in special medical journals,[1,3] and books[2].

This constitutional disability has the peculiarity of a multiple localization of its manifestations. Its most common generally recognized eleven symptoms are: urticaria, headaches, heartburn, indigestion (gas, nausea, pain, vomiting), canker-sores, dizziness, constipation, nervousness, neuralgia, abnormal tiredness, and chronic rhinitis. Other common symptoms or secondary consequences are essential hypertension, epilepsy, overweight, extra systoles and diabetes.

The genetic separation of familial nonreaginic allergy from the previously defined atopic (reaginic) group of allergies, which comprises hay-fever, bronchial asthma and atopic dermatitis, is clearly indicated.

1. The percentile incidence of atopy is variously reported at about 10; whereas both Locke and the writer found "more than 80 per cent" of the white population affected with idioblaptic allergy.
2. In a survey comprising 260 unselected individuals, the writer found the occurrence of atopy to be the same among those affected and among those unaffected with idioblaptic allergy (see Table I).

TABLE I. Showing the occurrence of atopy among 191 food-allergic persons and 69 persons free of food-allergy. (From Coca[1].)

Familial nonreaginic food allergy	191 (74.5 per cent)	atopy 11 (5.7 per cent)
No food allergy	69 (25.5 per cent)	atopy 4 (5.7 per cent)
Total	260 (100 per cent)	atopy 15 (5.7 per cent)

Patients who have been under the dietary treatment for nonreaginic food allergy are not included in this survey.

The presence of two or more of these manifestations constitutes strong indication of the constitutional disability, but an almost infallible objective sign is a practically pathognomonic character of the pulse. The *normal* pulse shows daily variations in rate not exceeding 16 beats per minute from low to high and a remarkable constancy of the daily maximum. Daily variations of 20 beats or more and variations of the daily maximum greater than two beats mark the food-allergic (idioblaptic) constitution with dependable certainty.

My own study and especially that of Arthur P. Locke and his associates provide satisfactory preliminary evidence of the familial nature of idioblapsis without, however, throwing any light on the mechanism of the inheritance.

The symptoms mentioned above have always been accompanied with a tachycardia, and their specific excitants could be identified with this objective sign, which regularly occurred within 90 minutes after exposure to the allergen by ingestion or inhalation or surface application. When the pulse was stabilized by avoidance of all specific excitants, all of the symptoms disappeared recurring after conscious or unwitting reexposure.

This occurrence itself points to a common etiology of the symptoms and that conclusion has been strengthened through the preliminary examinations that have been made of the families of persons that were affected and of those who seemed not to be affected with idioblapsis. With all of the more than 150 idioblaptic persons who have consulted me one or both of the parents have been

reported as suffering with characteristic symptoms. The data concerning 46 subjects are found in table 19, pp. 154-155 of the second edition of my monograph.[2] On the other hand persons exhibiting no symptoms usually report the absence of all symptoms in both parents (25 of 38 cases, table 23B, pp. 172-173, also table 18B, p. 152, monograph). More convincing evidence of the familial nature of idioblapsis is found in the published observations of Locke and his associates[1]. These authors write:

> The distribution of symptomatology between parent and child (Table II) was familial in character. Those of the parents reporting the presence of 2 or more symptoms A to L* in the one of themselves, but not the other, reported an incidence of 37 to 45 per cent in the children as against an incidence of 19 per cent in the children of parents neither of whom had 2 or more symptoms and as against an incidence of 63 per cent in the children of parents both of whom had 2 or more of symptoms A to L.
>
> *The 11 common symptoms plus stammering.

TABLE II. Number of Coca's 11 symptomatic indications of nonreaginic food-allergy in the children of parents with and without more than minimal evidence of such handicap.

Number of Parents	Number of Children	Number of Symptoms*		Per Cent of the Children with Multiple Symptoms
		Father	Mother	
284	222	0-1	0-1	19
70	57	>1	0.1	37
206	165	0-1	>1	45
238	199	>1	>1	63

*Number of symptoms as reported by the parents both for themselves and the children.

Implications

The evident implications of these findings urge a continuation of the investigation under more favorable working conditions; especially personal accessibility of the entire families to the investigator and more stringent application of the criteria, under the direction of an experienced geneticist. The study could begin with a survey of high-school students in a stable community of, say, 5,000 inhabitants or more.

The intrinsic conditions of such a study are favorable for the following reasons:

1. The symptomatic questionnaire is simple.
2. The pulse character can usually be ascertained within two days.
3. Over 80 per cent of the white population are affected.

The project would seem to make an enticing thesis for a doctorate. The writer offers his assistance freely.

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SEEDLESS PEPPERS

A Single Mendelian Recessive Character

LAWRENCE C. CURTIS AND JOHN SCARCHUK
University of Connecticut, Storrs, Conn.

LOOK: NO SEEDS!

Figure 9

Segregation in a progeny brought to light a seedless form, which is inherited as a simple recessive. Pollen is normal, but the ovaries are malformed and nonfunctional.

IN the course of a breeding program with peppers (*Capsicum frutescens*) at the Connecticut Agricultural Experiment Station at New Haven, a group of 33 plants, the progeny of a single plant selection, was observed to be composed of two types: 25 plants produced normal fruit, but eight produced fruit without seeds. Obviously, this culture constituted an F_2 population from a self-pollinated fruit in which the mutation had initially occurred.

The ovules of the seedless fruit were elongated and thread-like in contrast to the almost round ovules of the normal fruit. In all populations examined, approximately 90 per cent of the flowers on the seedless plants developed into parthenocarpic fruits. No tests were made to determine whether emasculated flowers on these plants would develop parthenocarpically.

Pollen from a seedless plant was used to pollinate flowers of sibs in the same culture. The resulting viable seed indicated that the seedless plants produced pollen which could effect fertilization.

Of the 25 normal plants in the original culture, 22 were progeny tested. Seven of these produced only normal plants; 15 produced normal and seedless plants in the ratio of 3:1.

Only normal plants were obtained in the F_1 generation when homozygous normal plants were pollinated with pollen from homozygous seedless plants. The

F_2 population from this cross segregated for normal and seedless plants in the ratio of 3:1.

When the F_1 plants (normal × seedless) were backcrossed to the seedless parent, the back-cross generation produced normal and seedless plants in the ratio of 1:1.

In Table I appear the ratios of the original F_2 culture and the results of the controlled pollination.

The close agreement to a 3:1 ratio in the F_2 populations, the 1:1 ratio in the backcross, and the 1:2:1 genetotypic ratios established in the original F_2 culture as determined in the analysis of the F_3 progeny clearly indicate that the seedless character is controlled by a single pair of recessive alleles. The results of the controlled pollinations and the genetic studies indicate that the homozygous recessive allele has no effect upon the viability of the pollen and that it produces a malformed, non-functional ovule.

TABLE I. Results of the original culture, and the results of the controlled pollinations.

Type of Cross		Progeny Normal	Seedless	Total	Ratio
Original segregating progeny (F_2 equivalent)		25	8	33	3:1
Homozygous normal × seedless (F_1 equivalent)		586	ALL NORMAL		
Heterozygous Normal selfed (F_1)		168	52	220	3:1
Heterozygous normal × seedless (backcross)		57	61	118	1:1
Total F_2	Observed	193	60	253	3:1
	Expected	189	63	253	3:1

SEEDLESS PEPPER
Figure 10

The fruit on the seedless plants are flatter than normal and do not reach as large a size as fruits with seeds. Since pollen is normal, the character can be carried in heterozygous stock, and equal numbers of seedless and normal plants can be "testcrossed" out in each generation.

✦

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